forest management note

Note No. 28 Northern Forest Research Centre Edmonton, Alberta

CONVERSION OF TREE VOLUME TO BIOMASS IN THE PRAIRIE PROVINCES

Provincial forest inventories in the prairie provinces provide information on the merchantable volume of forest trees and related data. This information can be used with the help of appropriate conversion factors or equations to obtain biomass. Each tree species was considered individually for such conversions, and separate prediction equations based on provincial merchantability limits were derived for the construction of biomass tables presented in this Note.

The field data consisted of the sampling of 20 trees per species for the eight major tree species in each prairie province, (a total of 480 trees), distributed equally over four diameter classes. The data were used to obtain merchantable volume biomass equations for balsam fir (*Abies balsamea* (L.) Mill.), white birch (*Betula papyrifera* Marsh.), tamarack larch (*Larix laricina* (Du Roi) K. Koch), white spruce (*Picea glauca* (Moench) Voss), black spruce (*Picea mariana* (Mill.) B.S.P.), jack pine (*Pinus banksiana* Lamb.), balsam poplar (*Populus balsamifera* L.), and trembling aspen (*Populus tremuloides* Michx.). In addition, 60 lodgepole pine (*Pinus contorta* Dougl. var. *latifolia* Engelm.) and 60 alpine fir (*Abies lasiocarpa* (Hook.) Nutt.) were similarly sampled in Alberta. Laboratory, field, and computational procedures are detailed by Singh (1982).

The model used was of the form $W = aV^b$, where W is the ovendry weight (kg) of the whole tree above ground (with foliage), V is the green merchantable volume (from stump height, 0.3 m, to minimum top diameter, 7.6 cm diameter outside bark) in m^3, and a and b are model parameters (Fig.1).

The ovendry weights of biomass for the prairie provinces (Tables 1-10)[1] are estimated from the merchantable volume of the trees. The weight tables, though derived from data collected from the boreal and subalpine forest regions of the prairie provinces, should also be applicable in ecologically similar adjacent areas.

ACKNOWLEDGMENTS

The assistance of D.I. Campbell in deriving the biomass equations and in preparing the weight tables is acknowledged. The field data were collected as part of ENFOR Project P-92.

T. Singh
March 1984

REFERENCE

Singh, T. 1982. Biomass equations for ten major tree species of the prairie provinces. Environ. Can., Can. For. Serv., North. For. Res. Cent. Edmonton, Alberta. Inf. Rep. NOR-X-242.

[1] In the tables, the green merchantable volume of a tree up to the first decimal point is indicated by the first column and can be extended to the second decimal place by using the remaining column headings.

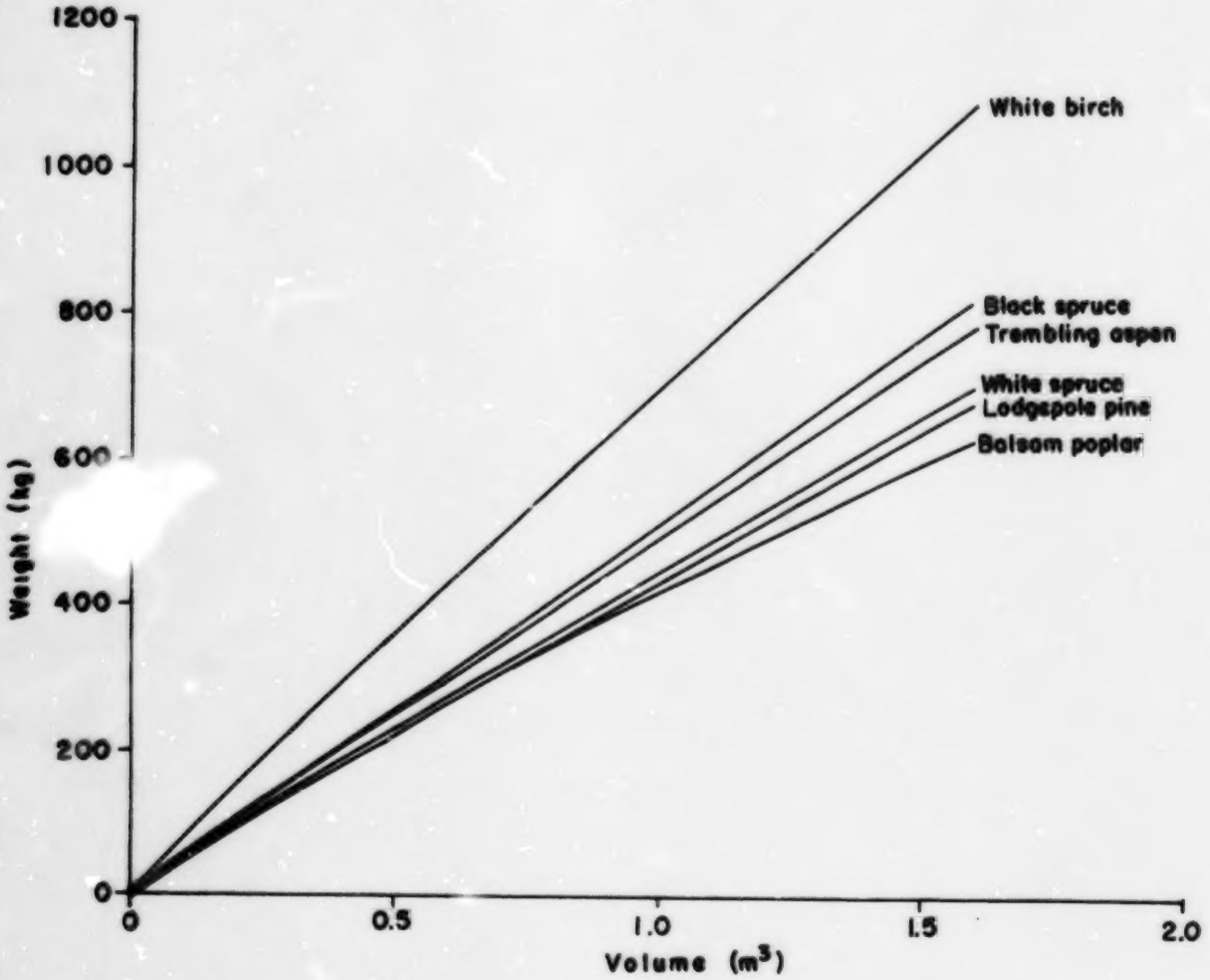

Figure 1. Green merchantable volume (m^3) and ovendry weight (kg) of the entire tree above ground for six species. Plots for tamarack larch, jack pine, alpine fir, and balsam fir are between those for black spruce and balsam poplar.

Table 1. Alpine fir whole tree above ground (with foliage) dry weight (kg)

MV (m^3)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0		6.79	12.69	18.30	23.74	29.04	34.23	39.35	44.39	49.38
0.1	54.31	59.19	64.03	68.83	73.60	78.33	83.03	87.71	92.35	96.98
0.2	101.58	106.15	110.71	115.25	119.76	124.26	128.74	133.21	137.66	142.09
0.3	146.51	150.91	155.30	159.68	164.04	168.40	172.74	177.07	181.38	185.69
0.4	189.98	194.27	198.55	202.81	207.07	211.31	215.55	219.78	224.00	228.21
0.5	232.41	236.61	240.79	244.97	249.14	253.31	257.46	261.61	265.76	269.89
0.6	274.02	278.14	282.26	286.37	290.47	294.57	298.66	302.74	306.82	310.89
0.7	314.96	319.02	323.08	327.13	331.18	335.22	339.25	343.28	347.31	351.32
0.8	355.34	359.35	363.35	367.35	371.35	375.34	379.33	383.31	387.29	391.26
0.9	395.23	399.20	403.16	407.11	411.06	415.01	418.96	422.90	426.83	430.77
1.0	434.69	438.62	442.54	446.46	450.37	454.28	458.19	462.09	465.99	469.89
1.1	473.78	477.67	481.55	485.43	489.31	493.19	497.06	500.93	504.80	508.66
1.2	512.52	516.37	520.23	524.08	527.93	531.77	535.61	539.45	543.29	547.12
1.3	550.95	554.77	558.60	562.42	566.24	570.05	573.87	577.68	581.49	585.29
1.4	589.09	592.89	596.69	600.48	604.28	608.06	611.85	615.64	619.42	623.20
1.5	626.97	630.75	634.52	638.29	642.06	645.82	649.59	653.35	657.10	660.86

Equation: $W = 434.694\ V^{0.903315}$ $R^2 = 0.96$ N = 46

Table 2. Balsam fir whole tree above ground (with foliage) dry weight (kg)

MV (m^3)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0		7.98	14.61	20.82	26.76	32.52	38.13	43.62	49.01	54.32
0.1	59.55	64.72	69.83	74.88	79.89	84.84	89.76	94.64	99.48	104.29
0.2	109.07	113.81	118.53	123.22	127.89	132.53	137.14	141.74	146.31	150.86
0.3	155.39	159.90	164.40	168.87	173.33	177.78	182.20	186.61	191.01	195.39
0.4	199.78	204.11	208.45	212.77	217.09	221.39	225.68	229.95	234.22	238.47
0.5	242.72	246.95	251.17	255.38	259.59	263.78	267.96	272.13	276.30	280.45
0.6	284.60	288.73	292.86	296.98	301.09	305.19	309.29	313.38	317.45	321.53
0.7	325.59	329.65	333.70	337.74	341.78	345.80	349.83	353.84	357.85	361.85
0.8	365.85	369.84	373.82	377.80	381.77	385.73	389.69	393.64	397.59	401.53
0.9	405.47	409.40	413.32	417.24	421.16	425.07	428.97	432.87	436.76	440.65
1.0	444.53	448.41	452.28	456.15	460.02	463.88	467.73	471.58	475.43	479.27
1.1	483.10	486.93	490.76	494.58	498.40	502.22	506.03	509.84	513.64	517.44
1.2	521.23	525.02	528.81	532.59	536.37	540.14	543.91	547.68	551.44	555.20
1.3	558.95	562.71	566.45	570.20	573.94	577.68	581.41	585.14	588.87	592.59
1.4	596.31	600.03	603.74	607.45	611.16	614.86	618.56	622.26	625.95	629.65
1.5	633.33	637.02	640.70	644.38	648.05	651.72	655.39	659.06	662.72	666.38

Equation: $W = 444.532\ V^{0.873007}$ $R^2 = 0.93$ N = 47

Table 3. Balsam poplar whole tree above ground (with foliage) dry weight (kg)

MV (m^3)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0		7.39	13.58	19.39	24.96	30.36	35.63	40.80	45.87	50.87
0.1	55.80	60.67	65.49	70.26	74.98	79.66	84.31	88.92	93.49	98.04
0.2	102.55	107.04	111.51	115.94	120.36	124.75	129.12	133.47	137.80	142.11
0.3	146.41	150.68	154.94	159.18	163.41	167.62	171.82	176.00	180.17	184.33
0.4	188.47	192.60	196.72	200.83	204.92	209.01	213.08	217.14	221.19	225.23
0.5	229.26	233.29	237.30	241.30	245.29	249.27	253.25	257.22	261.17	265.12
0.6	269.06	273.00	276.92	280.84	284.75	288.65	292.55	296.44	300.32	304.19
0.7	308.06	311.92	315.77	319.62	323.46	327.30	331.12	334.95	338.76	342.57
0.8	346.38	350.18	353.97	357.76	361.54	365.31	369.08	372.85	376.61	380.36
0.9	384.11	387.86	391.60	395.33	399.06	402.79	406.51	410.22	413.93	417.64
1.0	421.34	425.04	428.73	432.42	436.10	439.78	443.46	447.13	450.80	454.46
1.1	458.12	461.77	465.42	469.07	472.71	476.35	479.98	483.62	487.24	490.87
1.2	494.49	498.10	501.71	505.32	508.93	512.53	516.13	519.72	523.31	526.90
1.3	530.49	534.07	537.65	541.22	544.79	548.36	551.92	555.49	559.04	562.60
1.4	566.15	569.70	573.25	576.79	580.33	583.87	587.40	590.93	594.46	597.98
1.5	601.51	605.02	608.54	612.05	615.57	619.07	622.58	626.08	629.58	633.08

Equation: $W = 421.342\ V^{0.877980}$ $R^2 = 0.98$ N = 46

Table 4. Black spruce whole tree above ground (with foliage) dry weight (kg)

MV (m^3)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0		5.12	10.26	15.40	20.54	25.68	30.83	35.98	41.13	46.28
0.1	51.43	56.58	61.73	66.88	72.04	77.19	82.35	87.50	92.66	97.81
0.2	102.97	108.13	113.28	118.44	123.60	128.76	133.92	139.08	144.24	149.40
0.3	154.56	159.72	164.88	170.04	175.20	180.36	185.53	190.69	195.85	201.01
0.4	206.18	211.34	216.50	221.67	226.83	231.99	237.16	242.32	247.49	252.65
0.5	257.82	262.98	268.15	273.31	278.48	283.64	288.81	293.97	299.14	304.31
0.6	309.47	314.64	319.81	324.97	330.14	335.31	340.47	345.64	350.81	355.98
0.7	361.14	366.31	371.48	376.65	381.82	386.98	392.15	397.32	402.49	407.66
0.8	412.83	418.00	423.17	428.34	433.50	438.67	443.84	449.01	454.18	459.35
0.9	464.52	469.69	474.86	480.03	485.20	490.37	495.54	500.71	505.88	511.06
1.0	516.23	521.40	526.57	531.74	536.91	542.08	547.25	552.42	557.60	562.77
1.1	567.94	573.11	578.28	583.45	588.63	593.80	598.97	604.14	609.31	614.49
1.2	619.66	624.83	630.00	635.18	640.35	645.52	650.69	655.87	661.04	666.21
1.3	671.39	676.56	681.73	686.91	692.08	697.25	702.43	707.60	712.77	717.95
1.4	723.12	728.29	733.47	738.64	743.82	748.99	754.16	759.34	764.51	769.69
1.5	774.86	780.03	785.21	790.38	795.56	800.73	805.91	811.08	816.26	821.43

Equation: $W = 516.226\ V^{1.001660}$ $R^2 = 0.98$ N = 47

Table 5. Jack pine whole tree above ground (with foliage) dry weight (kg)

MV (m^3)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0		5.16	10.20	15.20	20.16	25.11	30.04	34.95	39.86	44.75
0.1	49.63	54.51	59.37	64.23	69.09	73.94	78.78	83.62	88.45	93.28
0.2	98.10	102.92	107.74	112.55	117.36	122.16	126.97	131.77	136.56	141.35
0.3	146.14	150.93	155.72	160.50	165.28	170.06	174.83	179.60	184.37	189.14
0.4	193.91	198.67	203.44	208.20	212.95	217.71	222.47	227.22	231.97	236.72
0.5	241.47	246.22	250.96	255.70	260.45	265.19	269.93	274.66	279.40	284.13
0.6	288.87	293.60	298.33	303.06	307.79	312.51	317.24	321.97	326.69	331.41
0.7	336.13	340.85	345.57	350.29	355.00	359.72	364.43	369.15	373.86	378.57
0.8	383.28	387.99	392.70	397.40	402.11	406.82	411.52	416.22	420.93	425.63
0.9	430.33	435.03	439.73	444.43	449.12	453.82	458.51	463.21	467.90	472.60
1.0	477.29	481.98	486.67	491.36	496.05	500.74	505.43	510.11	514.80	519.48
1.1	524.17	528.85	533.53	538.22	542.90	547.58	552.26	556.94	561.62	566.30
1.2	570.98	575.65	580.33	585.00	589.68	594.35	599.03	603.70	608.37	613.05
1.3	617.72	622.39	627.06	631.73	636.40	641.06	645.73	650.40	655.07	659.73
1.4	664.40	669.06	673.73	678.39	683.05	687.71	692.38	697.04	701.70	706.36
1.5	711.02	715.68	720.34	725.00	729.65	734.31	738.97	743.62	748.28	752.94

Equation: $W = 477.288\ V^{0.983019}$ $R^2 = 0.98$ N = 48

Table 6. Lodgepole pine whole tree above ground (with foliage) dry weight (kg)

MV (m^3)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0		5.19	10.12	14.95	19.72	24.44	29.12	33.78	38.41	43.02
0.1	47.61	52.19	56.75	61.29	65.82	70.34	74.85	79.34	83.83	88.31
0.2	92.77	97.23	101.68	106.13	110.57	115.00	119.42	123.84	128.25	132.65
0.3	137.05	141.44	145.83	150.21	154.59	158.96	163.33	167.70	172.06	176.41
0.4	180.76	185.11	189.45	193.79	198.13	202.46	206.78	211.11	215.43	219.75
0.5	224.06	228.37	232.68	236.98	241.28	245.58	249.88	254.17	258.46	262.75
0.6	267.03	271.31	275.59	279.87	284.14	288.41	292.68	296.95	301.21	305.47
0.7	309.73	313.99	318.24	322.49	326.74	330.99	335.24	339.48	343.72	347.96
0.8	352.20	356.44	360.67	364.90	369.13	373.36	377.59	381.81	386.03	390.25
0.9	394.47	398.69	402.90	407.12	411.33	415.54	419.75	423.95	428.16	432.36
1.0	436.56	440.76	444.96	449.16	453.36	457.55	461.74	465.93	470.12	474.31
1.1	478.50	482.68	486.87	491.05	495.23	499.41	503.59	507.77	511.94	516.12
1.2	520.29	524.46	528.63	532.80	536.97	541.13	545.30	549.46	553.63	557.79
1.3	561.95	566.11	570.27	574.42	578.58	582.73	586.89	591.04	595.19	599.34
1.4	603.49	607.63	611.78	615.93	620.07	624.21	628.36	632.50	636.64	640.78
1.5	644.91	649.05	653.19	657.32	661.46	665.59	669.72	673.85	677.98	682.11

Equation: $W = 436.564\ V^{0.982308}$ $R^2 = 0.99$ N = 48

Table 7. Tamarack larch whole tree above ground (with foliage) dry weight (kg)

MV (m^3)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0		7.59	14.38	20.89	27.24	33.47	39.60	45.65	51.63	57.55
0.1	63.43	69.25	75.04	80.79	86.51	92.19	97.84	103.47	109.07	114.65
0.2	120.20	125.73	131.25	136.74	142.21	147.67	153.11	158.53	163.94	169.33
0.3	174.71	180.07	185.42	190.76	196.09	201.40	206.70	211.99	217.27	222.54
0.4	227.80	233.04	238.28	243.51	248.73	253.93	259.13	264.33	269.51	274.68
0.5	279.85	285.01	290.16	295.30	300.43	305.56	310.68	315.80	320.90	326.00
0.6	331.09	336.18	341.26	346.33	351.40	356.46	361.52	366.56	371.61	376.65
0.7	381.68	386.70	391.72	396.74	401.75	406.75	411.75	416.75	421.74	426.72
0.8	431.70	436.67	441.64	446.61	451.57	456.52	461.48	466.42	471.36	476.30
0.9	481.24	486.17	491.09	496.01	500.93	505.84	510.75	515.66	520.56	525.45
1.0	530.35	535.24	540.12	545.00	549.88	554.76	559.63	564.50	569.36	574.22
1.1	579.08	583.93	588.78	593.63	598.47	603.31	608.15	612.98	617.81	622.64
1.2	627.46	632.28	637.10	641.92	646.73	651.54	656.34	661.15	665.95	670.74
1.3	675.54	680.33	685.12	689.90	694.68	699.46	704.24	709.02	713.79	718.56
1.4	723.32	728.09	732.85	737.61	742.36	747.12	751.87	756.62	761.36	766.10
1.5	770.85	775.58	780.32	785.05	789.78	794.51	799.24	803.96	808.69	813.40

Equation: $W = 530.347\ V^{0.922289}$ $R^2 = 0.96$ N = 47

Table 8. Trembling aspen whole tree above ground (with foliage) dry weight (kg)

MV (m^3)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0		5.46	10.77	16.03	21.26	26.46	31.64	36.80	41.95	47.09
0.1	52.21	57.33	62.44	67.54	72.63	77.71	82.79	87.86	92.93	97.99
0.2	103.04	108.09	113.14	118.18	123.22	128.25	133.28	138.31	143.33	148.35
0.3	153.36	158.38	163.38	168.39	173.39	178.39	183.39	188.39	193.38	198.37
0.4	203.36	208.34	213.32	218.30	223.28	228.26	233.23	238.20	243.17	248.14
0.5	253.11	258.07	263.03	267.99	272.95	277.91	282.86	287.81	292.77	297.72
0.6	302.66	307.61	312.56	317.50	322.44	327.38	332.32	337.26	342.19	347.13
0.7	352.06	356.99	361.93	366.85	371.78	376.71	381.64	386.56	391.48	396.40
0.8	401.33	406.24	411.16	416.08	421.00	425.91	430.82	435.74	440.65	445.56
0.9	450.47	455.38	460.29	465.19	470.10	475.00	479.90	484.81	489.71	494.61
1.0	499.51	504.41	509.30	514.20	519.10	523.99	528.89	533.78	538.67	543.56
1.1	548.45	553.34	558.23	563.12	568.01	572.89	577.78	582.66	587.55	592.43
1.2	597.31	602.19	607.07	611.95	616.83	621.71	626.59	631.47	636.34	641.22
1.3	646.09	650.97	655.84	660.71	665.58	670.45	675.33	680.19	685.06	689.93
1.4	694.80	699.67	704.53	709.40	714.26	719.13	723.99	728.86	733.72	738.58
1.5	743.44	748.30	753.16	758.02	762.88	767.74	772.60	777.45	782.31	787.16

Equation: $W = 499.508\ V^{0.980765}$ $R^2 = 0.98$ N = 47

Table 9. White [illegible] whole tree above ground (with foliage) dry weight (kg)

MV (m^3)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0		8.99	17.33	25.43	33.39	41.25	49.02	56.72	64.37	71.96
0.1	79.51	87.02	94.49	101.93	109.34	116.72	124.07	131.40	138.71	145.99
0.2	153.26	160.50	167.73	174.94	182.13	189.31	196.47	203.62	210.75	217.87
0.3	224.98	232.07	239.15	246.22	253.28	260.33	267.37	274.39	281.41	288.41
0.4	295.41	302.40	309.38	316.35	323.31	330.26	337.20	344.14	351.07	357.99
0.5	364.90	371.81	378.71	385.60	392.48	399.36	406.23	413.10	419.96	426.81
0.6	433.65	440.49	447.33	454.15	460.98	467.79	474.60	481.41	488.21	495.00
0.7	501.79	508.58	515.36	522.13	528.90	535.66	542.42	549.18	555.93	562.67
0.8	569.41	576.15	582.88	589.61	596.33	603.05	609.77	616.48	623.18	629.89
0.9	636.59	643.28	649.97	656.66	663.34	670.02	676.70	683.37	690.03	696.70
1.0	703.36	710.02	716.67	723.32	729.97	736.61	743.25	749.89	756.52	763.15
1.1	769.78	776.40	783.02	789.64	796.26	802.87	809.47	816.08	822.68	829.28
1.2	835.88	842.47	849.06	855.65	862.23	868.82	875.39	881.97	888.54	895.11
1.3	901.68	908.25	914.81	921.37	927.93	934.48	941.04	947.58	954.13	960.68
1.4	967.22	973.76	980.30	986.83	993.36	999.89	1006.42	1012.94	1019.47	1025.99
1.5	1032.51	1039.02	1045.53	1052.05	1058.55	1065.06	1071.57	1078.07	1084.57	1091.07

Equation: $W = 703.360\ V^{0.946751}$ $R^2 = 0.93$ N = 45

Table 10. White spruce whole tree above ground (with foliage) dry weight (kg)

MV (m^3)	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0		5.46	10.61	15.65	20.62	25.54	30.42	35.26	40.08	44.87
0.1	49.64	54.39	59.12	63.84	68.54	73.23	77.91	82.57	87.22	91.86
0.2	96.49	101.11	105.73	110.33	114.92	119.51	124.09	128.67	133.23	137.79
0.3	142.34	146.89	151.43	155.96	160.49	165.02	169.54	174.05	178.56	183.06
0.4	187.56	192.05	196.54	201.03	205.51	209.98	214.45	218.92	223.39	227.85
0.5	232.30	236.76	241.21	245.65	250.10	254.53	258.97	263.40	267.83	272.26
0.6	276.68	281.10	285.52	289.93	294.34	298.75	303.16	307.56	311.96	316.36
0.7	320.75	325.15	329.54	333.92	338.31	342.69	347.07	351.45	355.82	360.20
0.8	364.57	368.94	373.30	377.67	382.03	386.39	390.75	395.10	399.45	403.81
0.9	408.16	412.50	416.85	421.19	425.53	429.87	434.21	438.55	442.88	447.21
1.0	451.54	455.87	460.20	464.53	468.85	473.17	477.49	481.81	486.13	490.44
1.1	494.75	499.07	503.38	507.69	511.99	516.30	520.60	524.90	529.21	533.51
1.2	537.80	542.10	546.39	550.69	554.98	559.27	563.56	567.85	572.14	576.42
1.3	580.70	584.99	589.27	593.55	597.83	602.10	606.38	610.65	614.93	619.20
1.4	623.47	627.74	632.01	636.27	640.54	644.80	649.07	653.33	657.59	661.85
1.5	666.11	670.37	674.62	678.88	683.13	687.39	691.64	695.89	700.14	704.39

Equation: $W = 451.544\ V^{0.958852}$ $R^2 = 0.98$ N = 46

Canada

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